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Forest Service

United States Department of Agriculture

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Yellow-Poplar

An American Wood

Yellow-poplar is one of the most important commercial hardwood species in the United States. Since 1972 it has ranked second only to the oaks in the volume of hardwood lumber production. Annual growth and ready supply of saw timber have increased sharply in recent years. Because of its vigorous response to intensive management, availability, high quality, and good working properties, yellow-poplar will continue to be a favored species among wood-using industries.

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Yellow-Poplar
(*Liriodendron tulipifera* L.)

Charles B. Vick[1]

Distribution

The natural range of yellow-poplar extends over most of the Eastern United States—northward into Massachusetts, central New York, and Michigan; westward into Illinois, Arkansas, and Louisiana; and southward to the Gulf Coast and central Florida (fig. 1). The most extensive stands grow on the mountain slopes and plateaus of West Virginia, Virginia, North Carolina, Tennessee, Kentucky, and Georgia and in the lower Ohio River basin.

Yellow-poplar is distributed over a wide range of climatic conditions. The extremes of temperature vary from the moderately severe winters of southern New England, about 20 °F, to nearly frost-free winters in Florida. Summer temperatures reach 100 °F over a large part of the natural range for the species. At the northern end of its range, where low temperatures are limiting, yellow-poplar is commonly found in valleys and stream bottoms at elevations below 1,000 feet. In the Appalachian mountains, it grows along stream bottoms, in coves, and on moist slopes to an elevation of 4,500 feet. At the southern end of its range, where high temperatures and excess soil moisture may be limiting, the species is generally restricted to well-drained stream bottoms. Rainfall varies from 30 inches on drier sites to more than 80 inches in some areas of the Appalachians. Where rainfall is well distributed over a long growing season, and in particular where rainfall is adequate early in the growing season, yellow-poplar makes rapid growth.

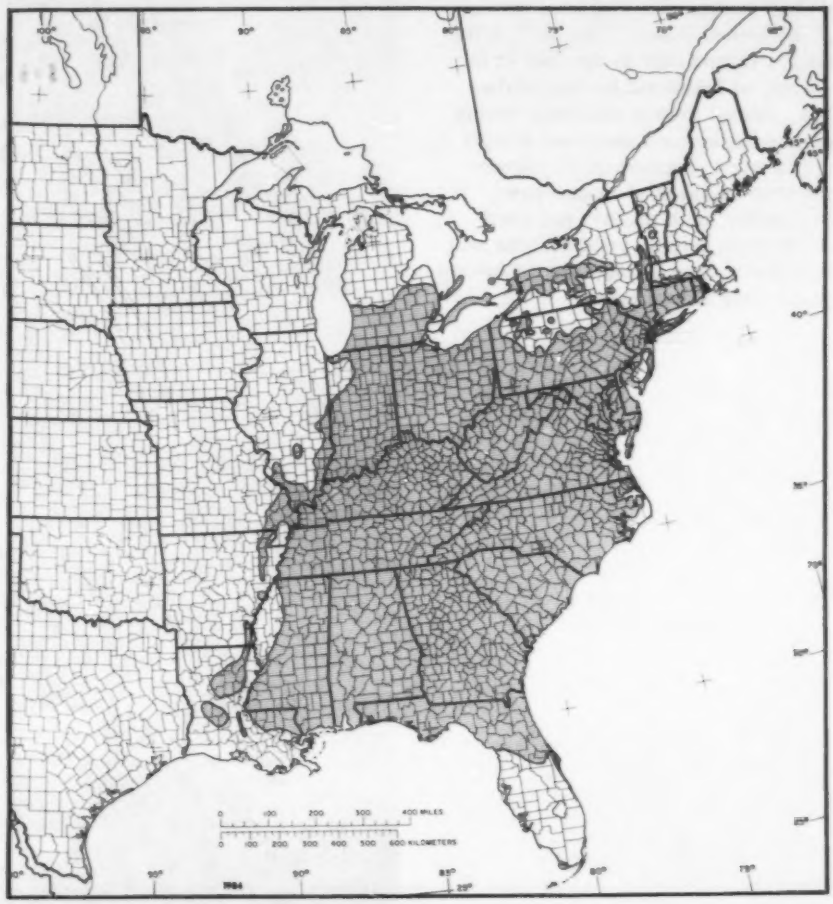

Figure 1—Natural range of yellow-poplar.

The distribution of yellow-poplar is controlled rather strictly by soil and moisture requirements. Where it is a dominant species in a forest cover type, yellow-poplar will be found only on the best sites. It is a major species in four forest cover types—pure yellow-poplar; yellow-poplar and eastern hemlock *(Tsuga canadensis)*; yellow-poplar, white oak *(Quercus alba)*, and northern red oak *(Quercus rubra)*; and yellow-poplar and sweetgum *(Liquidambar styraciflua)*. It is a minor component of 12 other forest types.

Description and Growth

The mature yellow-poplar has a striking appearance. In forest stands, its trunk is very straight and tall, and clear of lateral branches for considerable distance up the bole. Even though most yellow-poplar forests have been cut within the last 50 years, some older trees can occasionally be found that have attained a height of 160 feet or more and a massive trunk, 8 feet or more in diameter. It is probably the tallest of all broad-leaved trees in the Eastern United States.

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The leaves of yellow-poplar are distinctive, with a silhouette resembling a tulip (fig.2). They are 4 to 6 inches in breadth, and mostly four-lobed. The base and apex are nearly truncate, or the apex may be broadly notched. The flowers appear in late May or June after the leaves unfold. They are cup-shaped, 1½ to 2 inches wide, with six light greenish-yellow petals arranged in two rows. The flowers are a favorite source of nectar for honey bees. The fruit is a 2½- to 3-inch-long, erect, conelike aggregate of terminally winged samaras. The samaras fall from a more or less persistent axis at maturity. Each samara contains one or two seeds that mature from early August in the North to late October in the South. Peak dissemination occurs in October and November. Twigs are moderately stout, reddish brown, and bitter to the taste (fig. 3). Terminal buds are half an inch long, flattened, and appear "duck-billed" because only two outer bud scales are visible. The bark on young trees is dark green and smooth with a white, spotty appearance. Later the bark breaks up into long, rough, interlacing, rounded ridges, separated by deep ash-gray fissures (fig. 4).

Yellow-poplar is a prolific seeder—300,000 seeds per acre is not uncommon. Because of inefficient pollination, only about 10 percent of the seeds are viable in most trees; however, some trees produce 35 percent sound seeds. The normal seed-bearing age is 15 to 20 years, but trees as young as 9 or as old as 200 years can bear seeds. Successful establishment of yellow-poplar seedlings requires that an adequate number of viable seeds fall on mineral soil that is moist and well drained. Direct sunlight is essential for early growth, but some sheltering of seedlings by a light cover of grasses or bushes is needed. Once seedlings are established they must maintain a dominant position relative to other vegetation if they are to survive. This usually means heavy cutting of timber—either clearcutting, seed-tree cutting, or selection cutting—to provide

Figure 2—Mature leaf, twig, fruit, and flower of yellow-poplar.

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openings of ½ to 1 acre in size to admit adequate lighting. It is important that the forest floor be scarified to expose mineral soil and to minimize vegetative competition.

Yellow-poplar is inherently capable of growing vigorously on favorable sites during the seedling and sapling stages. During this period, however, soil moisture and drainage must be adequate, protection from drying and frost heaving is essential, and competition from nearby sprout growth must not be severe. Sometimes competing vegetation must be cut out to free developing seedlings. On favorable sites, the success of regeneration can usually be determined by the vigor and size of the seed reproduction after the third year. Trees may grow a few inches to a foot in height during the first year. Rapid growth begins in the second year; the 5-year height may be 10 to 18 feet. An 11-year-old naturally reproduced tree 50 feet tall has been recorded.

Yellow-poplar sprouts readily and vigorously from stumps, and frequently develops satisfactorily in clumps. Sprout stands, however, are not as desirable as seeded stands or plantations. Trees from stump sprouts are likely to develop heartrot, or the stump may rot away, leaving little support for the tree. Nevertheless, sprouts are quite vigorous, often outgrowing both yellow-poplar seedlings and the sprouts of competing species.

Yellow-poplar is a shade-intolerant species. Although it grows on a variety of soil types, it grows most rapidly on moist, well-drained fertile soils. Trees growing under optimum conditions can be harvested after 50 years for sawtimber and after 50 to 75 years for veneer-quality trees.

Yellow-poplar is unusually free from disease. Though subject to various canker, stain, and decay fungi, it is seldom extensively damaged. Several foliage insects such as moths, gall flies, and scale insects attack yellow-poplar,

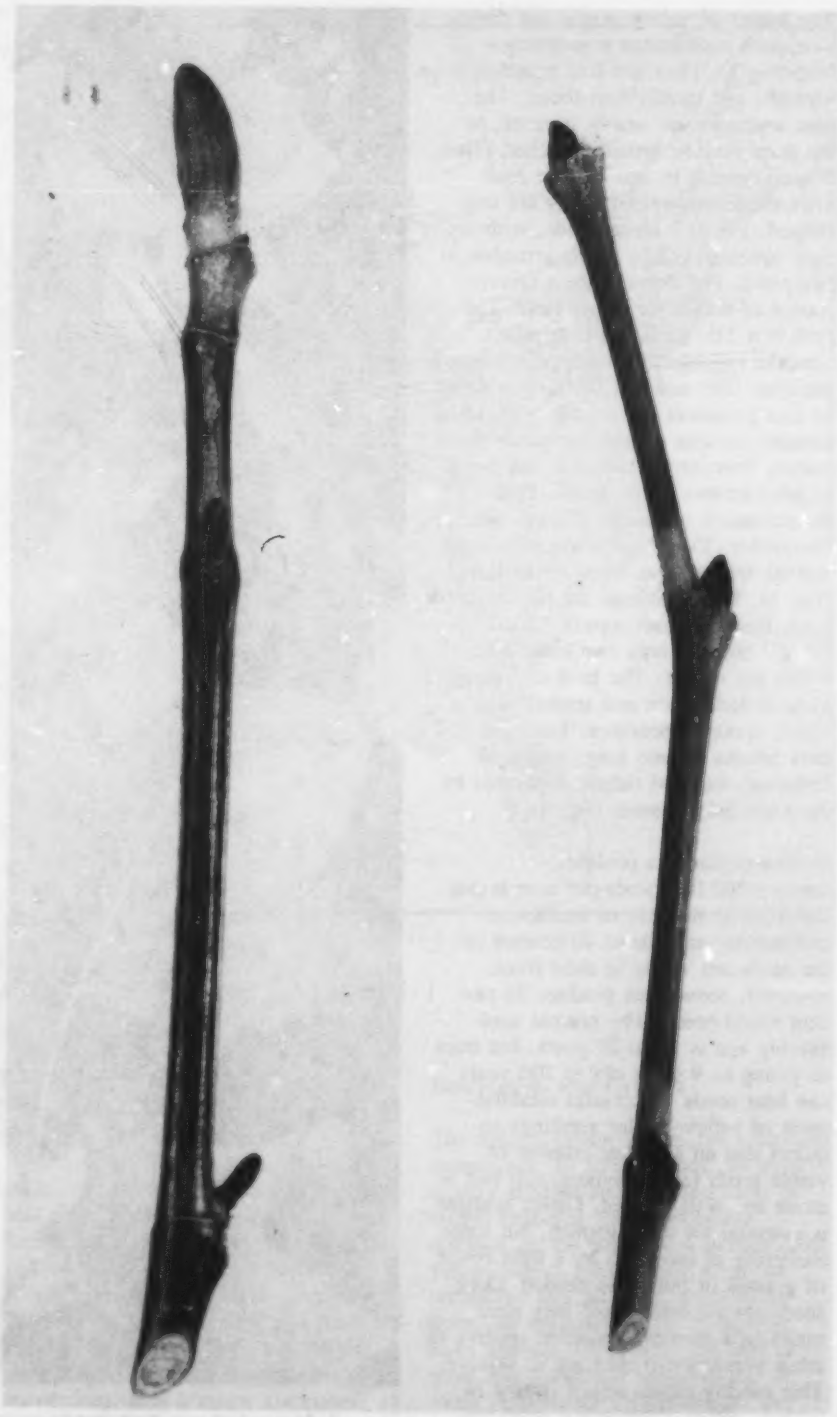

Figure 3—Twig and buds of yellow-poplar.

Figure 4—Bark of mature yellow-poplar.

but the damage is not serious. Sapwood and heartwood borers occasionally cause minor damage.

Common Names

The accepted common name, yellow-poplar, is misleading because the true poplars are found only in the willow family. The tree also bears other descriptive names, such as tuliptree, tulip-poplar, white-poplar, white wood, and poplar.

Related Commercial Species

Small quantities of southern magnolia *(Magnolia grandiflora)* and sweetbay *(Magnolia virginiana)* timbers, because of their similarity to yellow-poplar, are often mixed with and sold as yellow-poplar.

Supply

The 1977 nationwide forest survey placed the net volume of yellow-poplar sawtimber on commercial timberland at 34,111 million board feet, a 36-percent increase from the 25,092 million feet recorded in 1970 and a 61-percent increase from the 21,202 million feet recorded in 1963. These increases in yellow-poplar volume far exceed the gains in total hardwoods. For all hardwoods, the percent gain from 1970 to 1977 was 15 percent and only 25 percent from 1963 to 1977.

The largest volume of sawtimber, 43 percent of the total, was in Virginia, North Carolina, and South Carolina. The six Middle Atlantic States contained about 19 percent of the total, mostly located in West Virginia, Pennsylvania, and Maryland. Tennessee, Alabama, and Mississippi accounted for 15 percent. The eight Central States contained about 13 percent, mostly in Kentucky and Ohio. Most of the remaining volume, about 9 percent of the total, was located in Georgia.

Net annual growth of yellow-poplar sawtimber was 2,137 million feet in the

1977 survey, a remarkable 65-percent increase over the net annual growth recorded in 1970. Net annual removals in 1977 were 847 million feet, down 7 percent from 909 million feet in 1970. Growth exceeds drain by a comfortable margin, ensuring an abundant supply of yellow-poplar for years to come.

Production

The first recorded value for yellow-poplar lumber production was 320 million board feet in 1869. Production reached an all-time high of 1,118 million feet in 1899, then declined to an all-time low of 86 million feet in 1932. Production then rose sharply, reaching a peak of 883 million feet in 1950. This level of yellow-poplar production has not been surpassed since then. Over the period 1960 to 1979, yellow-poplar lumber production only increased slightly overall. Since 1960, production of yellow-poplar lumber has accounted for a relatively constant proportion (averaging 9 percent) of total hardwood production. Over the past 20 years, yellow-poplar and the maples have been almost equal in volume of production, often exchanging second and third rankings behind the first-place oaks.

Veneer-log production was about 26 million board feet in 1905 and is now about 150 million feet. In 1976, it was estimated at approximately 102 million board feet.

Characteristics and Properties

The growth rings of yellow-poplar are delineated by whitish lines of terminal parenchyma cells. The pores are so small they cannot be seen without a hand lens and are uniformly distributed throughout the growth ring. The wood rays are distinct to the naked eye and nearly uniform in width. The grain in flat-sawn lumber is easily visible, but it is not prominent enough for figured furniture woods.

Yellow-poplar sapwood is white and often striped. The heartwood is commonly tan but varies in color, ranging from tan to greenish brown and including shades of purple, dark green, black, blue, and yellow. These colorations are not known to affect the physical properties of the wood but may be objectionable if the wood is to have a natural finish.

The wood is generally straight-grained and comparatively uniform in texture. Timber from old-growth trees is moderately light in weight whereas that from second-growth trees is heavier, harder, and stronger. Selected wood of second-growth trees is suitable for gunstocks. Yellow-poplar has an average specific gravity of 0.40 (oven-dry weight and green volume) and weighs about 29 pounds per cubic foot at 12 percent moisture. Among commercially important hardwoods in the United States, yellow-poplar wood ranks in the lower one-third of the range of the following mechanical properties: specific gravity, bending strength, toughness, impact resistance, work to maximum load, crushing strength, fiber stress at proportional limit, shear strength, tensile strength, and side hardness. Its ranking for stiffness in bending is somewhat higher but still in the lower half.

Yellow-poplar has the reputation of being one of the easiest of all hardwoods to work with hand and machine tools. Among 28 important furniture woods, it ranks about average in machining qualities. Yellow-poplar planes well and has good turning and boring qualities. The wood is about average in mortising and in accepting nails and screws without splitting. However, it is poor in shaping and sanding characteristics. It is one of the easiest of woods to bond with many types of adhesives over a wide range of bonding conditions. It accepts and holds paint well and is easily stained. During seasoning, the lumber is intermediate in its tendency to warp. The initial shrinkage is relatively large, but the wood stays in place well after drying. The lumber dries quickly with only minimal loss of quality in air seasoning yards, forced-air driers, and dry kilns.

Principal Uses

In its primary manufacturing stages, yellow-poplar is cut into lumber, veneer, bolts, and pulpwood. Lumber is by far the largest use. In secondary manufacturing, lumber is cut mostly for furniture, interior finish, core stock for veneered furniture panels and plywood, and dimension stock. As a result of improved sawing and drying techniques, yellow-poplar is now being used for structural lumber, as well as the traditional softwoods. Selected lumber is used for gunstocks. The lumber is also used to make a host of miscellaneous items such as musical instruments, morticians' goods, toys, novelties, hatblocks, and sporting goods. Much of the lower grade lumber is made into pallets, shipping crates and boxes, and slack-cooperage staves.

Yellow-poplar is well suited to manufacturing veneer, particularly by the rotary-cutting method. Most of the veneer is peeled from bolts in southeastern plants to make utility veneers, i.e., crossbands, cores, and backs for plywood panels. At one time, the veneer was considered by many authorities as the best American crossband material. Yellow-poplar plywood is used for furniture and shipping containers. Veneers are also used extensively in wire-bound boxes and crates for fruit, berries, and other produce.

Short logs of yellow-poplar go into dimension stock, excelsior, particle board, and other specialty product mills. Particle board made from yellow-poplar and other species is gradually replacing furniture core-stock that was traditionally made from solid yellow-poplar boards.

Yellow-poplar is included in an important group of soft, low-density hard-

woods called the "poplars" that are used in pulp and paper manufacture. They can be pulped by chemical, semichemical, and groundwood processes to yield short-fibered pulps, relatively low in strength but suitable for various grades of wrapping and printing papers, container boards, and insulating boards.

References

Barrett, J.W., ed. Regional silviculture of the United States. New York: John Wiley & Sons; 1980. 551 p.

Fowells, H.A., comp. Silvics of forest trees of the United States. Agric. Handb. 271. Washington, DC: U.S. Department of Agriculture; 1965. 762 p.

Harlow, W.M.; Harrar, E.S.; White, F.M. Textbook of dendrology. 6th ed. New York: McGraw-Hill; 1979. 510 p.

Hawley, R.C.; Smith, D.M. The practice of silviculture. New York: John Wiley & Sons; 1962. 525 p.

Little, E.L., Jr. Checklist of United States trees (native and naturalized). Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture; 1979. 375 p.

Miller, W.D. An annotated bibliography of southern hardwoods. Tech. Bull. 176. Raleigh, NC: North Carolina Agricultural Experiment Station; 1967. 358 p.

Panshin, A.J.; de Zeeuw, C. Textbook of wood technology. 4th ed. New York: McGraw-Hill; 1980. 722 p.

Panshin, A.J. [and others]. Forest products. New York: McGraw-Hill; 1962. 538 p.

Renshaw, J.F.; Doolittle, W.T. Silvical characteristics of yellow-poplar. Res. Pap. SE-89. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1958. 18 p.

Schoenike, R.F. Yellow-poplar *(Liriodendron tulipifera)*, an annotated bibliography to and including 1974. Clemson, SC: Clemson University Department of Forestry; 1980. (unnumbered pages).

U.S. Department of Agriculture. An analysis of the timber situation in the United States—1952–2030. For. Resour. Rep. 23. Washington, DC: U.S. Department of Agriculture; 1982. 499 p.

U.S. Department of Agriculture, Forest Service. An assessment of the forest and range land situation in the United States. FS-345. Washington, DC: U.S. Department of Agriculture, Forest Service; 1980. 631 p.

U.S. Department of Agriculture, Forest Service. The outlook for timber in the United States. For. Resour. Rep. 20. Washington, DC: U.S. Department of Agriculture; 1973. 367 p.

U.S. Department of Agriculture, Forest Service. Seeds of woody plants in the United States. Agric. Handb. 450. Washington, DC: U.S. Department of Agriculture; 1974. 883 p.

U.S. Department of Agriculture, Forest Service. Timber trends in the United States. For. Resour. Rep. 17. Washington, DC: U.S. Department of Agriculture; 1965. 235 p.

U.S. Department of Agriculture, Forest Service. Veneer log production and receipts in the eastern United States by state and species, 1963. For. Resour. Note WO–6. Washington, DC: U.S. Department of Agriculture, Forest Service; 1964. 5 p.

U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. Wood handbook: wood as an engineering material. Agric. Handb. 72. Rev. ed. Washington, DC: U.S. Department of Agriculture; 1974. 428 p.

U.S. Department of Commerce, Bureau of the Census. Historical statistics of the United States, colonial times to 1970. Bicentennial edition, Part 1. Washington, DC: U.S. Department of Commerce; 1975. 543 p.

U.S. Department of Commerce, Bureau of the Census. Lumber production and mill stocks, 1979. Current Industrial Reports, MA-24T(79)-1. Washington, DC: U.S. Department of Commerce; 1980.

U.S. Department of Commerce, Bureau of the Census. Statistical abstract of the United States: 1975. 96th ed. Washington, DC: U.S. Department of Commerce; 1975. 659 p.

U.S. Department of Commerce, Bureau of the Census. Statistical abstract of the United States: 1980. 101st ed. Washington, DC: U.S. Department of Commerce; 1980. 736 p.

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